

## **Economic Interactions Between the Shrimp and Red Snapper Fisheries in the U.S. Gulf of Mexico**

One of the more challenging fishery management and economic issues in the Southeast Region concerns the incidental bycatch of juvenile red snapper by shrimp trawlers in the U.S. Gulf of Mexico. Significant quantities of a large variety of finfishes are caught routinely as incidental bycatch during the course of shrimp trawling (Nichols and Pellegrin<sup>1</sup>). While some of the bycatch has market value, most of it has little or no value and is discarded to make room for the more valuable shrimp.<sup>2</sup> Further, most of the discarded finfish are killed in the landing, culling, and discard process. Juvenile red snapper constitute one of the most important species discarded.

The incidental bycatch of juvenile red snapper has become a serious problem for fishery managers because it contributes significantly to the depleted status of the red snapper resource in the Gulf of Mexico. It has been estimated that less than 20% of each year class of juvenile red snappers survive the period of exposure to the shrimp fishery, and that the red snapper stocks cannot recover unless the mortality from shrimp trawling can be reduced by at least 50% (Goodyear<sup>3</sup>). As a result, the incidental catch and discard of juvenile red snapper by shrimpers significantly affect commercial and recreational fishermen who target the adult stocks. Juvenile red snapper become vulnerable to trawl gear during the peak, late-summer

shrimping season and continue to be incidentally caught and discarded for more than a year (Goodyear<sup>3</sup>).

The Gulf of Mexico Fishery Management Council currently regulates recreational and commercial red snapper fishermen because the red snapper resource is severely overfished.<sup>4</sup> The commercial fishery for red snapper is regulated with a 15-inch minimum size limit, a quota followed by closure of the fishery when the quota is reached, and a two-tiered system of trip limits under which permit holders with a significant catch history may land up to 2,000 pounds of red snapper per trip while other permit holders are limited to 200 pounds per trip. Annual renewal of the permits requires fishermen to demonstrate that at least 50% of their earned income was obtained from commercial fishing or the operation of a charter or head boat. The recreational fishery is regulated with minimum size and bag limits which can be changed in order to restrain the recreational catch to its annual allocation. Recreational and commercial quotas are set annually, and the 1996 quotas are about 4.5 million pounds for each sector.<sup>5</sup> The minimum size limit for commercial and recrea-

<sup>1</sup>Nichols, S., and G. J. Pellegrin. 1992. Revision and update of estimates of shrimp fleet bycatch 1972-1991. Natl. Mar. Fish. Serv., Southeast Fish. Cent., Miss. Lab., Pascagoula.

<sup>2</sup>*Penaeid* shrimps support the most valuable commercial fishery in the Gulf of Mexico. In 1994, fishermen landed approximately 206 million pounds (whole weight) of shrimp and earned gross ex-vessel revenues of \$463 million, which accounted for 10% of total commercial landings and 57% of total ex-vessel revenues received by U.S. commercial fishermen in the Gulf of Mexico (NMFS, 1995).

<sup>3</sup>Goodyear, C. P. 1995. Red snapper in U.S. Waters of the Gulf of Mexico. Contrib. MIA-95/96-05, NMFS Southeast Fish. Sci. Cent., Miami Lab., Miami, Fla., 171 p.

<sup>4</sup>A biological stock assessment completed in 1995 found that the red snapper resource currently exhibits a ratio of spawning potential of less than 4%, whereas the Gulf of Mexico Fishery Management Council has as biological goals the attainment and maintenance of a spawning potential ratio of at least 20%. The spawning potential ratio is defined as the ratio of the biomass of spawners per recruit in the current population vs. what would exist in the unfished population. Current estimates of the spawning potential ratio are found in Goodyear (text footnote 3).

<sup>5</sup>Commercial landings of red snapper exhibited an almost uninterrupted decline from about 14 million pounds in 1965 to 2.7 million pounds in 1990, the last year before quotas were imposed. Because of a relatively fixed quota, fishermen annually landed about 3.1 million pounds of red snapper from 1992 to 1995. Similarly, the estimated recreational catch declined from over 10 million pounds during the early 1980's to only 2 million pounds by 1986 and has since risen to about 5.5 million pounds in 1994 (Goodyear, text footnote 3).

tional reef fishermen is scheduled to increase to 16 inches in 1998. However, the timing of increases in the minimum size limit for recreational fishermen may be accelerated, and the bag limit may become more restrictive in an effort to curtail quota overruns by recreational fishermen. The recreational quota was exceeded in recent years (Goodyear<sup>3</sup>), but the recreational fishery was not closed because there is no real-time monitoring of the recreational catch.

If an ITQ program was implemented, it would have significant and positive economic consequences. Further, as will be noted, an ITQ system will provide the framework for capturing the potential economic benefits from rebuilding the red snapper stock that is related to a reduction in shrimp bycatch.

Given that the Council's minimum long-term goal of a 20% ratio of spawning potential cannot be attained by the target date of 2019 if the incidental mortality of juvenile red snappers by shrimp trawlers is not curtailed (Goodyear<sup>3</sup>), the Council is currently preparing an amendment to the Gulf of Mexico Shrimp FMP to reduce shrimp bycatch by at least 50%. The amendment is controversial because conservation of the red snapper resource via a reduction in shrimp bycatch will mean increased costs for shrimpers while potential benefits would accrue to other commercial and recreational fishermen who target the adult bycatch stocks. Management possibilities being considered under the amendment include area closures, seasonal closures, and the use of bycatch reduction devices (BRD's) in the shrimp trawls.

Regardless of the management device chosen, preliminary analyses suggest that the primary cost of reducing bycatch would consist of the value of shrimp not landed that otherwise would be landed. For example, the mandated use of BRD's would entail the loss of some shrimp per unit of effort. Restrictions on shrimp trawling effort during seasons and/or areas when and where bycatch is most prevalent would also result in a loss of shrimp harvest. The aggregate loss in shrimp catches may result in ex-vessel price increases, but even so, total revenues to shrimpers would still decline because ex-vessel demand for shrimp is price elastic due to the high availability of imported shrimp. Another cost to shrimpers could be expected in the form of higher production costs. Shrimpers who comply with rules designed to reduce incidental bycatch would incur the costs of purchasing



*Shrimp trawl bycatch (NMFS photo by James Nance).*

BRD's, modifying their gear, and/or disrupting their normal fishing patterns to avoid areas with large concentrations of juvenile red snappers. Consumers of shrimp also would suffer if discard abatement resulted in smaller supplies of shrimp available at higher prices. In this event, larger quantities of imported shrimp would replace some of the reduction in domestic landings, but total quantities available for consumption would decrease because the supply of imports is less than infinitely elastic.

Commercial and recreational red snapper fishermen could benefit in several ways from a reduction in the incidental catch and discard of juvenile red snapper. First, a reduction in bycatch mortality could increase the allowable catches of adult red snapper, which are adjusted annually, by shifting some of the burden of stock enhancement to the shrimp fishery. Red snapper fishermen would benefit immediately if the Gulf Council opted to relax regulatory constraints by allowing them to harvest larger annual quotas. On the other hand, if current regulations on the red snapper fisheries remained unchanged, a reduction in the incidental catch and discard of juvenile red snapper would allow the red snapper resource to recover more quickly to desired levels. In this event, red snapper fishermen would benefit with larger annual quotas in the long-term made possible by faster recovery of the fish stock. Second, recreational and commercial red snapper fishermen would benefit via a potential reduction in harvesting costs. A reduction

in the numbers of juvenile red snapper discarded would increase the numbers of adult red snapper available for capture, both directly as additional juveniles recruit to their adult habitats and over time through a larger spawning population, and would make both locating and harvesting red snapper less time consuming and, hence, less costly.

In the longer term, however, the reductions in harvesting costs would tend to disappear if the existence of larger red snapper populations encourages additional commercial and recreational effort, as is likely under the current open-access type regulations. This is where an ITQ system for the commercial portion of the stocks would be of great use in allowing the potential economic gains from larger stocks to become reality. The implementation of an ITQ system can be fully expected to result in a significant rise in average ex-vessel prices and should result in harvesting efficiencies that would significantly decrease the total cost of harvesting. However, given the absence of similar controls on overall effort by recreational fishermen, there is some chance that a portion of the potential economic gains for that group may not be realized.

Because an ITQ program for management of the commercial allocation of the red snapper stocks has not yet been implemented, the actual effect of a reduction in the incidental catch and discard of juvenile red snapper on ex-vessel prices for red snapper is ambiguous. Current management of the commercial red snapper fishery with restrictive quotas has introduced the psychology of the "derby fishery," in which individual fishermen must fish more intensively earlier in the season to maximize their shares of the overall catch before the quota is reached and the season is closed. While monthly catches of red snapper were relatively uniform throughout the year before the implementation of restrictive quotas, the entire year's catch now is landed in less than 2 months, and these landings are accompanied by sharp declines in ex-vessel prices. If a reduction in bycatch enables commercial fishermen to harvest additional quantities of red snapper, and if the larger allowable harvests in combination with an ITQ system relieve the incentive for derby fishing, then ex-vessel prices would undoubtedly increase relative to current prices. On the other hand, if the derby fishery prevailed, then ex-vessel prices would decline further as increasingly larger quantities would be landed during a relatively

short time period.

Consumers would also be affected by management to reduce the incidental bycatch and discard of juvenile red snapper. If derby fishing prevailed in the commercial red snapper fishery, at the beginning of the fishing year consumers of red snapper would benefit from lower levels of incidental bycatch because larger supplies of red snapper would become available at lower cost. However, if the incentives for derby fishing were nullified, then consumption of red snapper at the beginning of the fishing year would decrease and prices would be higher, while consumption during the middle and end of the fishing year would increase and prices would be lower. Larger domestic supplies would displace some imported red snapper, but total quantities available for consumption likely would increase.

From an economic perspective, the optimum reduction in bycatch would be determined by comparing the marginal benefits and marginal costs of each additional reduction in bycatch. In principle, bycatch should be reduced as long as the marginal benefit exceeds the marginal cost of doing so, although these values have not yet been estimated, due to a lack of data. Marginal cost includes the extra cost that would be incurred by shrimpers and consumers from each additional reduction in bycatch, including the present value of losses that would be incurred in the future as well as current-year losses. The easiest, least-cost methods of reducing bycatch would be adopted first. Additional reductions in bycatch can only be achieved with increasingly restrictive regulations on shrimping activity, which suggests that marginal cost increases with each additional reduction in bycatch.

Marginal benefit includes the extra benefit that would be received by harvesters and consumers of red snapper and other animals that would be saved from being discarded, including the present value of the extra current and future benefits that would be generated with each additional reduction in bycatch. Each additional reduction in bycatch is expected to increase total benefits to commercial and recreational red snapper fishermen, but at a decreasing rate. Each additional 10% reduction in bycatch probably would yield successively smaller additions to adult red snapper stocks due to the existence of other environmental factors that tend to limit stock growth. Also, each addition to adult red snapper stocks probably would yield successively smaller additions to profits of

commercial fishermen as they increase their investments in fishing effort to harvest additional quantities, and would yield successively smaller additions to enjoyment of recreational fishermen due to the economic principle of diminishing marginal utility. For example, the first five fish caught per trip by recreational fishermen would yield more enjoyment than the second five if bag limits were less restrictive.

In summary, biologists have determined that the red snapper resource in the Gulf of Mexico is depleted for several reasons, including the application of too much fishing effort by commercial and recreational red snapper fishermen and the incidental bycatch and discard of juvenile red snapper by the shrimp trawl fleet. The ensuing debate about how best to restore the red snapper population to desirable levels involves many technological, political, and economic factors. Among them are technological interaction in which shrimping gear inadvertently harvests juvenile red snapper,

management interaction between the Reef Fish FMP and Shrimp FMP, competition between commercial and recreational fishermen and among fishermen with different gear types within each group, economic trade-offs over time among various harvesting groups and between different groups of consumers, and the current uncertainty regarding whether or not the commercial management structure for red snapper will shift to an ITQ-based system. The interaction between the shrimp and red snapper fisheries of the U.S. Gulf of Mexico constitutes a management problem that is controversial, challenging, and, as yet, unresolved.

#### LITERATURE CITED

NMFS.

1995. Fisheries of the United States, 1994. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Curr. Fish. Stat. 9400.